



THE ONTARIO WATER RESOURCES COMMISSION

REPORT ON

Survey of Possible Pollution in the Vicinity of
Gas Well Operations in Lake Erie and Lake St. Clair.

By: John H. Neil,
Biologist.

Date of Inspection:

Lake Erie -- July 23rd & 24th

Lake St. Clair -- October 7th

Date Reported:

November 25th, 1958.

PARLIAMENT BUILDINGS - TORONTO

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INTRODUCTION:

Drilling operations for the production of natural gas began in Lake Erie in 1913. From 1913 til the end of 1957 a total of 87 off-shore wells had been drilled in Lake Erie. Most of the early wells were drilled within a few hundred yards of the shoreline, but in recent years considerable interest has been shown in the development of off-shore gas reserves and at the present time most or all of the Canadian waters of Lake Erie have been leased by exploration companies. At present, drilling operations in Lake Erie are concentrated in the vicinity of Port Alma and it is in this region that the pollution survey in Lake Erie was made.

PURPOSE OF THE INVESTIGATION:

With the increase in drilling activity in the waters bordering Southwestern Ontario, concern was expressed by the commercial fishermen for the effects which this operation might have on their commercial fishing operation.

In June of this year a meeting was called by Dr. Harkness, Chief of the Fish and Wild Life Division, of the Department of Lands and Forests, between interested members of the division and the Ontario Water Resources Commission to discuss ways and means by which this problem might be investigated. At that time, it was agreed that the Water Resources Commission would undertake three phases of an investigation to determine if

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gas well operations contributed significant amounts of pollution.

These included the following:

- 1) A series of water samples to be taken from the lake and from the wastes produced in the various phases of gas well development and production.
- 2) A series of samples of bottom fauna in the vicinity of drilling, producing and leaking gas wells to determine whether there have been any significant change in these sensitive bottom organisms.
- 3) A bioassay to determine the toxicity of natural gas.

About that time, the Department of Lands and Forests assigned one biologist to interview a large group of commercial fishermen from the effected areas to determine whether they had or had not been detrimentally effected by this industry. (See Appendix)

The chemical and biological survey was made on Lake Erie on July the 23rd and 24th and in Lake St. Clair on October 7th.

On August 5th the author attended a meeting between representatives of the Lake Erie Commercial Fishermen's Association, the Minister of the Department of Lands and Forests, the Honorable Mr. Spooner, other members of the Department of Lands and Forests and representatives of the Ontario Fuel Board. At that time the commercial fishermen outlined to Mr. Spooner their complaints relative to natural gas production in their area.

METHODS:

Chemical Sampling:

Sampling for chemical analyses was carried out in the

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vicinity of three wells.

1) Consolidated West Petroleum Well #40

This well was being drilled in a rock strata at a depth of 1,030 feet. Samples were taken of the bailings, the lake below the drilling platform and the lake 100 feet north of the derrick in the direction of the water drift.

2) M.L.O. #18

This well was being drilled at a depth of 1170 feet and was in a gas strata. Samples were taken of the bailings, the lake below the drilling platform and the lake 100 feet from the platform.

3) Submarine #4

This was a well that had been completed. It had, however, passed through a pocket of what is known as surface gas, and the gas was escaping by following up the outside of the well casing and bubbling to the surface. It could readily be seen on the surface as a large boil about four feet in diameter. Chemical samples were taken here at the surface and at the bottom and 100 feet from this leaking well at the surface and at the bottom.

Determinations for Hydrogen Sulphides were made from each sample at the time of collection. A separate sample for phenols was taken at each sampling point and preserved for later analyses in the laboratory. Water for the remaining analytical determinations were collected in 40 oz. bottles and returned to the laboratory for analyses.

Biological Sampling

Samples of the bottom fauna were taken with a one square foot Peterson dredge. The contents of the dredge were screened on the spot and preserved for later enumeration and identification.

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In general, samples were taken from the vicinity of three wells, Consolidated West Petroleum #40, M.L.O. #18, and Submarine #4. In addition, samples were taken in an area of producing wells. For controls or comparison with the samples taken in the vicinity of gas well drilling or production, two samples were taken immediately west of the producing area and an additional four samples were taken in a similar depth of water opposite Wheatley, a distance of about 14 miles west of the point where the previous samples were taken.

BIOASSAY

In order to determine whether gas leaking from the wells was toxic to fish, a bioassay was performed using natural gas at the laboratory. To determine the toxicity of the gas, five small fish (*C. Commersonii*) and *Rhinichthys* Sp.) were placed in a jar containing 3 litres of water. On two subsequent days, gas was bubbled through this water for a period of eight hours at the rate of 10 c.c. per minute. It was felt that by this means and toxicity of natural gas could be demonstrated.

OBSERVATIONS

Chemical Results

The results of the chemical sampling carried out during the survey are appended. In general, there is no appreciable effect on the chemical water quality of the lake except in the immediate vicinity of the drilling rigs. The samples which were taken along side the platform and immediately after bailings were dumped showed slight increases in chlorides and sulphate. The bailings themselves

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were very high in chlorides, sulphate and sulphides and apparently contained some phenol. The volume of this material dumped to the lake is very small (about 60 gal. every 3 hrs.) and apparently the dilution immediately reduces the concentrations to near normal levels or as is the case with the sulphides reacts chemically to oxidize them to innocuous compounds. There is some question as to the source of the phenols in the bailings as lubricants are used on the machinery and some of the phenols noted may be from this source.

Biological Observations

In general a community of organisms inhabits lake bottoms that is relatively stable in species composition under similar environmental conditions. There will be a chance variation in both numbers and species depending upon the particular square foot that is sampled but no gross change should be apparent. If this does happen it is indicative of pollution.

The lake bottom where some of these samples were collected was "gravelly" in nature and difficulty was encountered in getting a good sample. Where obvious errors from this cause were noted, a second sample was taken but it is possible that in certain instances small numbers were due to a loss of a portion of the sample.

In order to determine whether the bottom fauna had been effected by the gas wells, it was planned that a number of samples would be taken in the vicinity of present drilling operations and in an area where there was a concentration of producing gas wells. It was thought that a comparison between this information and that supplied by control samples, taken at a point some distance

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from any source of pollution, would demonstrate any deleterious effects.

The results of these studies indicated that there was no significant difference in types or numbers of bottom fauna between the drilling and producing areas and control areas. As these operations are not affecting the pollution sensitive bottom forms it seems unlikely that any serious pollution results from the drilling or production of natural gas in Lake Erie. The one possible exception to this observation was noted in the bottom sample taken at Submarine #4 from a point in or very close to the gas leak. At this point, oligochaete worms were the only animals found and it would seem likely that some toxicity was imparted to the immediate area by the large volumes of gas that were escaping through the water. This effect was apparently confined to the small area as the sample taken 100 feet from the well showed no change from the normal types and numbers of bottom organisms found elsewhere.

TOXICITY TO FISH

The possibility that certain substances toxic to fish which might be released by gas leaking into the water was investigated by performing a bioassay at this laboratory. Fish which were exposed in a small container to bubbling gas for two eight hour periods showed no signs of ill-effects and all test animals were alive after a total of forty-eight hours, in the containers.

It would appear that sufficient toxic substances are not produced as a result of drilling to cause harm to fish even in the immediate vicinity of the drilling rigs. At the time of this

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investigation shoals of minnows were noted to be swimming beneath the drilling platforms apparently unaffected and it was reported to be common practice for the operators to fish with some success off the drill rigs.

LAKE ST. CLAIR SURVEY

In Lake St. Clair one of the wells drilled about two years ago developed a gas leak which was reported to be surface gas leaking around the outside of the well casing. This leak has continued since that time with little diminution in flow. The volume of gas escaping is not nearly as large as the one reported in Lake Erie but is sufficient to cause a noticeable boil in a patch about two feet in diameter. A survey of chemical and biological conditions similar to that earlier conducted in Lake Erie was made in the vicinity of this gas leak.

RESULTS OF SAMPLES

Chemical

Three samples for chemical analyses were taken.

- 1) From the surface in the gas boil
- 2) 50 feet north of well
- 3) 1000 feet south of well

The results of these analyses indicate no apparent chemical change in the water as a result of the gas leak. Variations in the analytical results for B.O.D., chloride, sulphide, pH and sulphates from the three samples taken are not significant. It is interesting to note, however, that two samples contain significant amounts of phenol from some source other than the gas well.

Biological Results

Four bottom samples were taken to determine whether the gas leaking into the water effected the bottom fauna. Three samples were taken 100 feet or closer to the well while another was taken 1000 feet away for use as the control. The bottom fauna was found to be relatively rich in numbers and species and there is no indication that there was any detrimental effect from the gas leaking through the water. It should be noted that one mayfly nymph was taken right at the base of the leak apparently in good health. This insect is generally considered to be sensitive to pollution but it was apparently not being harmed by living in this position. In view of the large numbers of small clams found on the bottom all of the specimens were not collected for enumeration.

FISHING IN THE VICINITY OF THE GAS WELLS

In the immediate vicinity of the gas wells there are a number of commercial fishing operations. On both sides of the leak approximately 100 yards away are sets of square-type hoop nets that are apparently fished with success most of the year.

At the time of this investigation, the Department of Lands and Forests, made arrangements for setting nets in the immediate vicinity of the leaking well. A lime trap containing fish was also set over the gas boil.

The following is information on these investigations that has been supplied by the Aylmer District office (Dr. S. K. Reynolds, District Forester).

"Investigations of complaints of Delmar Jubenville concerning the effects of a leaking gas well in Lake St. Clair adjacent to his trap (modified hoop) nets,

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were carried out from October 6th, - 14th, 1958.

On October 6th, two small-mesh trap nets were set facing the leaking well on Lot 7 Dover Township. The six foot net #1 was set with the pot to the west of the well, and the smaller five foot net #2 was set with the pot facing the first on the opposite side of the well. The leads of both nets were placed as close to the well as possible.

These nets were lifted on October 7th and re-set.

They contained:

Net #1 3 rock bass
Net#2 13 rock bass, 2 perch

A wire cage 2½' long and 1' in diameter (approx) was set on bottom at the "boil" produced by the leaking gas, containing 13 rock bass and 1 perch.

The cage was picked up on October 10th. It was partially filled with mud, as a result of turbulence caused by a storm during the intervening three days. The perch and 12 rock bass were dead.

On October 12th (2.00 PM), 13 additional rock bass were placed in the cage, which was set by means of a buoy approximately two feet from the bottom, in the "boil" of the leaking well.

The cage was lifted on October 15th 10.00 AM. The 13 fish were alive and in good condition.

The trap nets were lifted on October 15th and removed.

They contained:

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Net #1 2 white bass
 1 stonecat
 2 yellow pickerel
 1 northern redhorse
 15 yellow perch
 4 rock bass

Net #2 1 white bass
 2 white sucker
 1 northern redhorse
 7 yellow perch
 2 rock bass
 1 mud puppy "

CONCLUSIONS

As a result of the chemical and biological study made concerning possible pollution from the gas well operations in Lake Erie and Lake St. Clair, it would appear that no significant change occurs in the chemical composition of the water either in the vicinity of the drilling operation or in the vicinity of leaking wells. Chemical determinations have indicated that the bailings from the drilling operation contains high amounts of chloride, sulphate, sul hides and perhaps some phenol, but because of the small volumes involved these substances are almost immediately lost by dilution. Gas escaping from the well is relatively insoluble and no toxicity is imparted to the water through which it passes.

Biological sampling indicate no adverse change in the bottom fauna in the drilling or producing areas. The one possible exception to this was a sample taken from the bottom at the point where gas is escaping from the Submarine #4 well in Lake Erie.

With respect to toxicity to fish, the results of the bioassay and the live trapping experiments and the presence of fish in the immediate vicinity of drilling operations indicates that no toxic hazard results from the drilling operations or the accidental escape of gas to the water.

Acknowledgements:

The survey on Lake Erie was made possible through the assistance of Mr. R. G. Ferguson and the research vessel Keenocay of the Research Division of the Department of Lands and Forests.

Arrangements for Lake St. Clair survey were made by Mr. Doug. Roseborough, District Biologist for the Department of Lands and Forests. His assistance in the field studies is appreciated.

APPENDIX

The following is a synopsis of the Lands and Forests report prepared by Mr. Carl F. Schenk entitled "A Report on Interviews with Commercial Fishermen of the Lake Erie District". 52 p.p.

Purpose

- 1) To record views of fishermen with respect to drilling operations.
- 2) To establish whether fishing has been detrimentally effected by these operations.

Methods

The author discussed any problem and recorded complaints from a group of informed fishermen from the various general fishing areas, in the three lakes involved. The following information was provided regarding exploration, drilling and gas well production.

Southern Lake Huron: Exploratory work only, no drilling.

Lake St. Clair: Exploratory work, 10 wells drilled, two classed as producers but apparently capped.

Eastern Lake Erie: (west to Elgin Kent boundary)
Exploratory work, 6 wells drilled.

Kent County: Exploratory work, 90 wells drilled of which about 69 are producing wells.

Essex County: Exploratory work about 5 wells drilled, one classed as producer.

Result of Survey

- 1) Most of the complaints from fishermen concerned physical interference with their fishing operations, including damage to gear by the mining company boats, hazards to navigation from improperly marked buoys and drilling rigs and possible closing of certain areas to various types of nets because of obstructions on the bottom.
- 2) The possibility of fish being frightened from productive areas by noises in the pipe line was commonly mentioned.
- 3) No cases of actual harm by pollution has been recorded though a number of fishermen mentioned this possibility. Sources of pollution described include leaking wells, residue from drilling operations and the possibility of escaping oil should an oil well be discovered.

The author of this report interviewed 106 commercial fishermen and outlined the individual opinions of each in this report.

Prepared by:

John H. Neil

A. J. E. Laporte

Director, Labs. & Research:

Approved - General Manager:

	Tendipedidae (Hedge Flies)	Chironomus (4 species)	Polypedilum 1231	Brillia	Cryptochironomus	Tribolium	Polypedilum 2 species	Oligoneurinae (Aquatic Diptera)	Simuliinae (Leeches)	Trichoptera (Caddis-flies)	Phlebotominae (May-flies)	Isopoda (Amphipods)	Amphipoda (Gammarus)	Polychaeta (Clams)	Centropoda (Snails)
<u>Gas well area</u>															
Consolidated West #40 at Boreak	2				1	2	1	18			1			7	1
NLO #18 100 ft. off derrick															
NLO #18 at derrick			1	2				39	1				1	6	1
Submarine #4 at well								6							
100 ft out	3		2				4	12	1						
1/2 mile west	9	2	1				3	4		1					
<u>Near Producing wells</u>															
1.5 miles S.E. of Con.															
West Dock															
#1 100 yards west of #4	7	2			1	4	1	9						4	
#2	7			2			2	46							
#8	8			1				12							
#16					1			30							
Near Port Alma	8	3	2		1	13		62	2		1		1	17	1
<u>Control Area</u>															
From Whentley Dock															
2.3 miles at 130°	43	9			3	32	3	27	1	3				1	
2.5 " " 130°	11	8				6		30							
2.5 " " 130°	12	4	1			10	2	22		2			2		
From Alma Dock															
3.96 " " 236°	5	1	2			2		35							
4.3 " " 236°	2							31		1					

ONTARIO WATER RESOURCES COMMISSION
CHEMICAL LABORATORIES

All analyses except pH reported in
p.p.m. unless otherwise indicated

WATER ANALYSIS

1 p.p.m. = 1 mgm. / litre
= 1 lb./100,000 Imp. Gals.

Municipality:		Report to: John H. Neil						c.c.		
Source: Lake Erie										
Date Sampled: July 23, 1958 by: J. Neil										
Lab. No.	Hardness as CaCO ₃	Alkalinity as CaCO ₃	Iron as Fe	Chloride as Cl	Fluoride as F	pH at Lab.	Phenol Equiv- alent. ppm.	Sulphate as SO ₄	B.O.D.	Sulphides as H ₂ S
W611				51,000		7.7	34	16,800	---	31.
W612				20.		7.9	3	58.0	---	0.0
W613				20.		8.0	2	55.0	---	0.0
W614				3,390		10.7	500	14,460.	---	342.
W615				40.		8.0	5	59.5	---	0.0
W616				19.		8.0	4	20.5	---	0.0
W617				21.		7.2	---	21.0	---	0.0
W618				19.		7.9	3	24.5	---	0.0
W619				20.		7.8	10	20.5	0.8	0.0
W620				20.		7.3	6	23.5	0.7	0.0
W611	Con. West Pet. Well #40 Bailing									
W612	Cons. West #40 at Derrick									
W613	Con. West Pet. 100' N. of Derrick									
W614	M.L.O. #18 Bailing									
W615	M.L.O. #18 at Derrick									
W616	M.L.O. #18 100' off Derrick									
W617	Submarine #4 bottom 100' from up well.									
W618	Submarine #4 surface 100' from Gas Leak									
W619	Submarine #4 Top at Gas Leak									
W620	Submarine #4 Bottom at Gas Leak									

Lake St. Clair

J. E. Reil

Looking Gas Well

October 7th, 1938.

	Tentipoda Cryptohieracium	Oligochaeta	Mirafina (Leeches)	Dipentostoma (May flies)	Amphipoda (Pinnarus)	Decapoda (Clams) Bivalvia	Gastropoda (Snails) Planorbidae	Amnicolidae
At well	8	4	2	1	1	54	10	33
50'	19	6	4			56	10	28
100'	12	20				108	15	54
1000'	19	2	6			45	10	26

ONTARIO WATER RESOURCES COMMISSION
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RIVER SURVEY

1 p.p.m. = 1 mgm. / litre
= 1 lb./100,000 Imp. Gals.

Watershed: **St. Clair Lake**

Report to: **J. Neil**

c.c.

Watercourse: **St. Clair**

Date Sampled: **Oct. 7/58** by: **J. Neil**

Sample Point No.	Lab. No.	5-Day B.O.D.	XXXXX Chloride Sulphide as Susp Cl as H₂S					Sulphate as SO ₄		Bacteriological Laboratory	
			Total	as Susp	as H₂S	as pH	Sample Temp. C p.p.b.			Lab. No.	M.F. Coliform Count per 100 ml.
	R1765	1.5		15	0.	7.6	0	19			
	R1766	1.2		14	0.	7.5	30	12			
	R1767	1.		17.5	0.	7.7	25	22			
	R1765	Bubbling well									
	R1766	50' north of well									
	R1767	1000' s. of well									

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APR 28 1969

OCT 19 1971

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